

# SALVATORE TORQUATO

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## EDUCATION

Ph.D. (M.E.) State University of New York at Stony Brook, 1981  
M.S. (M.E.) State University of New York at Stony Brook, 1977  
B.S. (M.E.) Syracuse University, 1975

## PROFESSIONAL EXPERIENCE

**Lewis Bernard Professor in Natural Sciences**, Princeton University, 2018

**Professor**, Chemistry, Princeton Center for Theoretical Science (Senior Fellow), and Princeton Institute for the Science and Technology of Materials (Associated Faculty in Physics, Program in Applied and Computational Mathematics, Department of Mechanical & Aerospace Engineering, and Department of Chemical Engineering), Princeton University, July 1992 to present.

**Visitor**, School of Natural Sciences, Institute for Advanced Study, Princeton, New Jersey (Sabbatical leave from Princeton University), February 2011 - August 2017.

**Visiting Professor**, Department of Physics and Astronomy, University of Pennsylvania, Philadelphia, Pennsylvania (Sabbatical leave from Princeton University), September 2012 - August 2013.

**Visitor**, School of Natural Sciences, Institute for Advanced Study, Princeton, New Jersey, September 2008 to August 2010.

**Member**, School of Natural Sciences, Institute for Advanced Study, Princeton, New Jersey (Sabbatical leave from Princeton University), September 2007 - August 2008.

**Senior Faculty Fellow**, Princeton Center for Theoretical Science, Princeton University, December 2005 - August 2013.

**Member**, School of Mathematics, Institute for Advanced Study, Princeton, New Jersey (Sabbatical leave from Princeton University), September 2003 - August 2004.

**Visiting Professor**, Center for Statistical Mechanics and Complexity, University of Rome, La Sapienza, Rome, Italy, June - July 2003.

**Member**, School of Mathematics, Institute for Advanced Study, Princeton, New Jersey (Sabbatical leave from Princeton University), September 1998 - August 1999.

**Professor**, Departments of Mechanical and Aerospace Engineering and of Chemical Engineering, North Carolina State University, July 1991 to June, 1992.

**Visiting Professor**, Courant Institute of Mathematical Sciences, New York University, and Engineering and Applied Sciences, Yale University, September 1990 - June 1991.

**Associate Professor**, Departments of Mechanical and Aerospace Engineering and of Chemical Engineering, North Carolina State University, July 1985 - August 1990.

**Assistant Professor**, Departments of Mechanical and Aerospace Engineering and of Chemical Engineering, North Carolina State University, July 1982 to June 1985. Joint appointment with Chemical Engineering began January 1984.

**Assistant Professor**, Department of Mechanical Engineering, General Motors Institute, Flint, Michigan, January 1981 - June 1982.

**Research Assistant**, Department of Mechanical Engineering, State University of New York at Stony Brook, Doctoral Research, July 1978 - December 1980.

**Research Engineer**, Grumman Aerospace Corporation, Bethpage, New York, Analysis and measurements of the three-dimensional turbulent vortex flow occurring in an advanced-concept wind energy device, January 1977 - June 1978.

**Grumman Masters Fellow**, Grumman Aerospace Corporation, Worked in four different sections of the company (Propulsion, Thermodynamics, Energy Conservation, Research) doing thermodynamic, fluid dynamic and heat transfer experimentation and analyses, while pursuing a Masters degree, July 1975 - June 1977.

## RESEARCH INTERESTS

Statistical Mechanics of Liquids, Glasses, Quasicrystals and Crystals, Packing Problems, Hyperuniform Systems and Materials, Transport and Mechanical Properties of Heterogeneous Materials, Colloids and Self-Assembly Theory, Photonic Materials, Materials Optimization, Granular Media, Biological Materials, Percolation Theory, Image Science, Cancer Growth Modeling, Biophysics

## AWARDS AND HONORS

Lewis Bernard Professor in Natural Sciences, Princeton University, 2018  
American Chemical Soc. Joel Hildebrand Award in Theoretical Chemistry of Liquids, 2017  
Simons Foundation Fellowship in Theoretical Physics, 2012  
Fellow, Society for Industrial & Applied Mathematics, 2009

American Physical Society, David Adler Lectureship Award in Material Physics, 2009  
Member, Institute for Advanced Study, 2007 - 2008  
Society for Industrial & Applied Mathematics Ralph E. Kleinman Prize, 2007  
Fellow, American Physical Society, 2004  
Society of Engineering Science William Prager Medal, 2004  
Member, Institute for Advanced Study, 2003-2004  
Am. Soc. Mechanical Engineers Charles Russ Richards Memorial Award, 2002  
Guggenheim Memorial Foundation Fellow, 1998  
Member, Institute for Advanced Study, 1998-1999  
Am. Soc. Mechanical Engineers Gustus L. Larson Memorial Award, 1994  
Fellow, American Society of Mechanical Engineers, 1993  
Alcoa Foundation Distinguished Engineering Research Award (5-year period), 1989  
Alcoa Foundation Engineering Research Achievement Award, (1-year period), 1987  
Grumman Masters Fellow Award, 1975 - 1977

## **COURSES TAUGHT**

Statistical Mechanics (Graduate)  
Classical Thermodynamics (Graduate and Undergraduate)  
Random Heterogeneous Materials (Graduate)  
Random Walks in Biology and Chemistry (Graduate)  
Mathematical Methods for Engineering Analysis (Graduate)  
Statistical Theory of Fluids (Graduate) - Co-lecturer  
Mechanics of Ideal Fluids (Graduate)  
Materials Science and Engineering (Graduate and Undergraduate)  
Fluid Mechanics (Undergraduate)  
Solid Mechanics (Undergraduate)

## **RESEARCH SUPPORT**

Research support has been garnered from the following funding agencies: National Science Foundation, U. S. Department of Energy, Air Force Office of Scientific Research, National Institutes of Health, Petroleum Research Fund, Army Research Office, Office of Naval Research, and Defense Advanced Research Projects Agency.

## **PROFESSIONAL ACTIVITIES**

American Physical Society  
Society for Industrial and Applied Mathematics  
American Chemical Society  
Materials Research Society

## **Doctoral Dissertations Supervised Over the Last 12 Years**

Aleksandar Donev, “Jammed Packings of Hard Particles” (2006).

Obioma Uche, “Manipulation of the Density and Structure of Many-particle Systems” (2006).

Mikael C. Rechtsman, “Inverse Problems in Statistical Mechanics and Photonics” (2008).

Jana L. Gevertz, “Multi-Scale Mathematical Modeling of Heterogeneous Tumor Growth” (2009).

Yang Jiao, “Characterization of the Structure of Heterogeneous Materials and Particle Packings” (2010).

Robert D. Batten, “Unusual and Excited States in Classical Interacting Many-Particle Systems” (2011).

Chase E. Zachary, “Characterizing Fluctuations in the Structures of Many-Particle Distributions and Random Heterogeneous Media” (2011).

Adam B. Hopkins, “The Microstructures of Cold Dense Systems as Informed by Hard Sphere Models and Optimal Packings” (2012).

Étienne Marcotte, “Inverse Statistical Mechanics, Lattice Packings, and Glasses” (2013).

Miroslav Hejna, “Nearly-Hyperuniform Network Models of Amorphous Silicon” (2013).

Steven D. Atkinson, “Structure and Rigidity in Maximally Random Jammed Packings of Hard Particles” (2016).

Chaney Lin, “Advances in Natural Quasicrystals and Quasicrystal Tilings” (2017).

Ge Zhang, “Exotic Ordered and Disordered Many-Particle Systems with Novel Properties” (2017).

Duyu Chen, “Statistical Mechanics of Hyperuniform Materials and Particle Packings” (2018).

## INVITED LECTURES

1. **Bounds on the Transport Properties of Two-Phase Random Media**, Seminar given at the University of Pennsylvania, Philadelphia, Pennsylvania, April, 1982.
2. **Effective Thermal Conductivity of a Two-Phase Random Material**, Seminar given at Massachusetts Institute of Technology, Cambridge, Massachusetts, November, 1983.
3. **Effect of Microstructure on the Bulk Properties Two-Phase Disordered Media**, Seminar given at Clemson University, Clemson, South Carolina, February 1985.
4. **New Expression for the Effective Thermal Conductivity of a Wide Class of Two-Phase Disordered Composite Media**, 9th Symposium of Thermophysical Properties, Boulder, Colorado, June, 1985.
5. **Thermal Conductivity of Composites**, Seminar given at Stanford University, Stanford, California, August, 1985.
6. **Predicting Bulk Properties of Composites**, Seminar given at Duke University, Durham, North Carolina, October, 1985.
7. **Transport and Mechanical Properties of Two-Phase Porous and Composite Media**, Seminar given at Cornell University, Ithaca, New York, February, 1986.
8. **Microstructure and Transport Properties of Disordered Composite Media**, University of California Conference on Statistical Mechanics, Davis, California, March, 1986.
9. **Effective Transport Properties of Disordered Multiphase Media from the Microstructure**, SIAM Workshop on Multiphase Flow, Leesburg, Virginia, June, 1986.
10. **Transport and Mechanical Properties of Composite Media**, Seminar given at DuPont Research, Wilmington, Delaware, January, 1987.
11. **On Predicting the Rate of Diffusion-Controlled Reactions**, Seminar given at the Courant Institute of Mathematical Sciences, New York, New York, November, 1987.
12. **Transport Properties of Disordered Heterogeneous Media from the Microstructure**, Sixth Symposium on Energy Engineering Sciences, Argonne National Laboratories, Argonne, Illinois, May, 1988.
13. **Bounds on the Effective Transport and Elastic Properties of a Random Array of Cylindrical Fibers in a Matrix**, Applied Mechanics and Engineering Sciences Conference, University of California at Berkeley, California, June, 1988.
14. **Transport and Mechanical Properties of Inhomogeneous Materials**, Summer School on Inhomogeneous Materials, Royal Institute of Technology, Stockholm, Sweden, August, 1988.

15. **Transport Properties of Heterogeneous Media from the Microstructure**, Seminar given at the Benjamin Levich Institute for Physico-Chemical Hydrodynamics, City College of New York, New York, NY, October, 1988.
16. **Bounds on Various Electrostatic and Hydrodynamic Capacities**, SIAM Workshop on Random Media and Composites, Leesburg, Virginia, December, 1988. (with J. Rubinstein)
17. **Structure and Transport Properties of Porous Media**, Workshop on Porous Media Applications in Geosciences, Department of Energy, Germantown, Maryland, April, 1989.
18. **Statistical Characterization of the Microstructure of Heterogeneous Media**, Seminar given at Eastman Kodak Company, Rochester, New York, May, 1989.
19. **Microstructure and Bulk Properties of Random Media**, AMS-SIAM Summer Seminar, Mathematics of Random Media, Virginia Polytechnic Institute, Blacksburg, Virginia, June, 1989.
20. **Structure, Transport Properties, and Mechanical Properties of Heterogeneous Media**, Seminar given at Johns Hopkins University, Baltimore, Maryland, September 1989.
21. **Structure and Macroscopic Properties of Random Multiphase Media**, Seminar given at Duke University, Durham, North Carolina, January, 1990.
22. **Structure and Macroscopic Properties of Random Heterogeneous Media**, Seminar given at Yale University, New Haven, Connecticut, February, 1990.
23. **Prediction of Transport and Mechanical Properties of Random Heterogeneous Media**, Seminar given at Rensselaer Polytechnic Institute, Troy, New York, May, 1990.
24. **Problems in Random Media: Structure, Diffusion and Flow**, Seminar given at Courant Institute of Mathematical Sciences, New York, New York, October, 1990.
25. **Microstructure and Transport Properties of Random Heterogeneous Media**, Seminar given at Schlumberger-Doll Research Laboratory, Ridgefield, Connecticut, October, 1990.
26. **Random Heterogeneous Media: Structure and Macroscopic Behavior** Seminar given at Duke University, Durham, North Carolina, December, 1990.
27. **Link Between Flow and Diffusion in Porous Media**, Statistical Mechanics Meeting, Rutgers University, New Brunswick, New Jersey, December, 1990.
28. **Random Heterogeneous Media: Microstructure, Diffusion, and Flow**, Seminar given at Princeton University, Princeton, New Jersey, February, 1991.

29. **Diffusion, Flow and Elastic Behavior of Heterogeneous Materials**, Seminar given at the Levich Institute for Physico-Chemical Hydrodynamics, City College of New York, New York, New York March, 1991.
30. **Diffusion and Reaction Among Traps: Some Theoretical and Simulation Results**, Models for Non-Classical Reaction Rates, National Institutes of Health, Bethesda, Maryland, March, 1991.
31. **Transport and Mechanical Properties of Heterogeneous Materials**, Exxon Research and Engineering Company, Annandale, New Jersey, May, 1991.
32. **Random Heterogeneous Materials: Microstructure and Macroscopic Behavior**, Seminar given at the Johns Hopkins University, Baltimore, Maryland, May, 1991.
33. **Microstructure and Effective Properties of Random Particulate Media**, Euromech Conference on Random Particulate Media, Schumen, Bulgaria, June, 1991.
34. **Microstructure and Macroscopic Behavior of Random Heterogeneous Materials**, Conference on the Physics of Inhomogeneous Materials, International Center for Theoretical Physics, Trieste, Italy, June 1991.
35. **Macroscopic Behavior of Random Inhomogeneous Materials from the Microstructure**, Seminar given at the Ecole Polytechnique, Paris, France, June, 1991.
36. **NMR Relaxation in Porous Media**, Seminar given at the Institut Francais du Petrole, Paris, France, June, 1991.
37. **Morphology and Macroscopic Behavior of Random Heterogeneous Materials**, Seminar given at Princeton University, Princeton, New Jersey, October, 1991.
38. **Transport in Random Porous Media**, Tenth Symposium on Energy Engineering Sciences, Argonne National Laboratory, Argonne, Illinois, May 1992.
39. **Microstructure and Macroscopic Behavior of Heterogeneous Materials**, National Institute of Standards and Technology, Gaithersburg, Maryland, August, 1992.
40. **Connection Between Morphology and Effective Properties of Heterogeneous Materials**, American Society of Mechanical Engineers, Anaheim, California, November, 1992.
41. **Heterogeneous Materials**, Seminar given at the University of Pennsylvania, Philadelphia, Pennsylvania, November, 1992.
42. **Morphology and Macroscopic Behavior of Random Heterogeneous Media** Seminar given at Rutgers University, New Brunswick, New Jersey, December, 1992.
43. **Heterogeneous Materials: Macroscopic Properties and Microstructure**, Exxon Research, Annandale, New Jersey, January, 1993.

44. **Heterogeneous Materials for Fun and Profit**, Seminar given at the University of Pennsylvania, Philadelphia, Pennsylvania, March, 1993.
45. **Heterogeneous Materials: Macroscopic Behavior and Microstructure**, Seminar given at Michigan State University, East Lansing, Michigan, April, 1993.
46. **Microstructure and Macroscopic Behavior of Heterogeneous Media: A Unified Approach**, 69th Statistical Mechanics Meeting, Rutgers University, New Brunswick, New Jersey, May, 1993.
47. **Rigorous Link Between the Effective Elastic Moduli and Effective Conductivity of Composite Materials**, MEET'N'93 (Joint ASME, SES, and ASCE Meeting), Charlottesville, Virginia, June, 1993 (with L. V. Gibiansky).
48. **Macroscopic Behavior of Random Media from the Microstructure**, MEET'N'93 (Joint ASME, SES, and ASCE Meeting), Charlottesville, Virginia, June, 1993
49. **Numerical Simulations of the Mechanical Properties of Multi-phase Composites**, MEET'N'93 (Joint ASME, SES, and ASCE Meeting), Charlottesville, Virginia, June, 1993 (with E. J. Garboczi and A. R. Day ).
50. **Macroscopic Behavior of Random Heterogeneous Materials from the Microstructure**, National Science Foundation Workshop on *Statistical Characterization of Material Microstructure and its Relation to Material Performance*, The Catholic University of America, Washington, DC , June, 1993.
51. **Unified Methodology to Quantify the Morphology and Properties of Inhomogeneous Media**, Electrical Transport and Optical Properties of Inhomogeneous Media Conference, Guanajuato, Mexico, August, 1993.
52. **Unified Methodology to Characterize the Microstructure and Properties of Heterogeneous Materials**, Institute for Advanced Study, Princeton, New Jersey, October, 1993.
53. **Unified Methodology to Quantify the Morphology and Properties of Heterogeneous Materials**, Worcester Polytechnic Institute, Worcester, Massachusetts, October, 1993.
54. **Link Between the Conductivity and Elastic Moduli of Heterogeneous Materials**, American Institute of Chemical Engineers, St. Louis, Missouri, November, 1993.
55. **New Cross Property Relations for Composites**, American Society of Mechanical Engineers, New Orleans, Louisiana, December, 1993.
56. **Rigorous Link Between the Microstructure and Bulk Properties of Heterogeneous Materials**, Materials Research Society Meeting, San Francisco, California, April, 1994.



57. **Macroscopic Behavior of Random Media from the Microstructure**, Society of Industrial and Applied Mathematics on *Emerging Issues in Mathematics and Computation from the Materials Sciences*, Pittsburgh, Pennsylvania, April, 1994.
58. **Unified Methodology to Characterize the Microstructure and Properties of Composite Media**, Society of Industrial and Applied Mathematics on *Emerging Issues in Mathematics and Computation from the Materials Sciences*, Pittsburgh, Pennsylvania, April, 1994.
59. **Microstructure-Property Relations for Composite Materials**, Gordon Research Conference on *Solid State Studies in Ceramics*, New Hampton School, New Hampshire, August, 1994.
60. **Unified Methodology to Quantify the Microstructure and Properties of Composite Materials**, International Union of Theoretical and Applied Mechanics Symposium on *Microstructure-Property Interactions in Composite Materials*, Aalborg, Denmark, August, 1994.
61. **Morphology of Random Two-Phase Media**, Workshop on *Space-Filling on Problems*, Les Houches School of Physics, Les Houches, France, January, 1995.
62. **Transport and Mechanical Properties of Random Suspensions**, Seminar given at the Benjamin Levich Institute for Hydrodynamics, City College of New York, New York, NY, May, 1995.
63. **Transport Properties of Porous Media from the Microstructure**, Thirteenth Symposium on Energy Engineering Sciences, Argonne National Laboratory, Argonne, Illinois, May 1995.
64. **Structure and Properties of Disordered Heterogeneous Media Controlling Complex Microstructures**, American Ceramics Society, New Orleans, Louisiana, November, 1995.
65. **Rigorous Link Between the Electrical and Mechanical Properties of Composite Materials**, Symposium on Electrically Based Microstructural Characterization, Materials Research Society, Boston, Massachusetts, November, 1995.
66. **Random Heterogeneous Materials: Structure and Properties**, Seminar given at SUNY Stony Brook, Stony Brook, New York, February, 1996.
67. **A Unified Approach to Quantify the Structure and Properties of Heterogeneous Materials**, Seminar given in the Ceramics Dept. at Rutgers University, New Brunswick, New Jersey, February, 1996.
68. **Microstructure and Macroscopic Behavior of Random Heterogeneous Materials**, AFOSR Workshop on Structural Mechanics, Virginia Beach, Virginia, June, 1996.

69. **Random Heterogeneous Materials: Structure and Macroscopic Behavior**, Applied Mathematics Studies for Materials Studies and Industrial Applications, Pennsylvania State University, State College, Pennsylvania, October, 1996.
70. **Microstructure Characterization and Failure in Composites**, International Mechanical Engineering Congress and Exposition, American Society of Mechanical Engineers, Atlanta, Georgia, November, 1996.
71. **Morphology and Physical Properties of Random Heterogeneous Materials**, International Mechanical Engineering Congress and Exposition, American Society of Mechanical Engineers, Atlanta, Georgia, November, 1996.
72. **Design of Materials with Extreme Elastic or Thermoelastic Properties using Topology Optimization**, International Union of Theoretical and Applied Mechanics, Cairo, Egypt, March, 1997 (with O. Sigmund).
73. **On the Design of Hydrophone Piezocomposites**, International Union of Theoretical and Applied Mechanics, Cairo, Egypt, March, 1997 (with O. Sigmund).
74. **Composites with Extremal Thermal Expansion Coefficients**, Smart Materials Technologies, International Society for Optical Engineering San Diego, California, March, 1997.
75. **Optimal Design of Hydrophone Piezocomposites**, Smart Materials Technologies, International Society for Optical Engineering San Diego, California, March, 1997.
76. **Microstructure and Field Fluctuations in Random Media**, Mathematical Aspects of Materials Science, Society of Industrial and Applied Mathematics, Philadelphia, Pennsylvania, May, 1997.
77. **Conductivity and Microstructure of Hierarchical Composites**, Mathematical Aspects of Materials Science, Society of Industrial and Applied Mathematics, Philadelphia, Pennsylvania, May, 1997.
78. **Exact Expressions for the Effective Moduli of Random Media**, 77th Statistical Mechanics Meeting, Rutgers University, New Brunswick, New Jersey, May, 1997.
79. **Exact Series Expansions for Effective Stiffness Tensor of Composite Media**, International Society for Analysis, Applications and Computing, University of Delaware, Newark, Delaware, June, 1997.
80. **Transport Properties and Microstructure of Porous Media via Tomography**, Textile Research Institute, Princeton, New Jersey, November, 1997.
81. **Random Media: Exact Property Predictions and Reconstruction Techniques**, Seminar given at Yale University, New Haven, Connecticut, April, 1998.
82. **Reconstructing Heterogeneous Materials**, American Ceramics Society, Columbus, Ohio, May, 1998.

83. **Transport Properties of Porous Media from the Microstructure**, 18th Symposium on Energy Engineering Sciences, Argonne, Illinois, May, 1998.
84. **Reconstructing Heterogeneous Media: An Inverse Problem**, 13th US National Congress of Applied Mechanics, Gainesville, Florida, June, 1998.
85. **Exact Expression for the Effective Elastic Tensor of Disordered Composites**, 13th US National Congress of Applied Mechanics, Gainesville, Florida, June, 1998.
86. **Modeling of Physical Properties of Composite Materials**, 13th US National Congress of Applied Mechanics, Gainesville, Florida, June, 1998.
87. **Reconstructing Random Media**, Conference on Computational Physics 1998, Granada, Spain, August, 1998.
88. **Microstructure and Macroscopic Behavior of Random Heterogeneous Materials**, AFOSR Workshop on Structural Mechanics, Dayton, Ohio, October, 1998.
89. **Microstructure and Performance of Heterogeneous Materials**, Cabot Workshop on Dispersions, Dayton, Ohio, October, 1998.
90. **Random Packings of Spheres**, Institute for Advanced Study, Princeton, New Jersey, November, 1998.
91. **Reconstructing Random Media: An Intriguing Inverse Problem**, Benjamin Levich Institute for Physico-Hydrodynamics, City College at CUNY, New York, New York, December, 1998.
92. **Random Packings of Spheres: A Statistical-Mechanical Approach**, Workshop on *Kepler Conjecture for Sphere Packings*, Institute for Advanced Study, Princeton, New Jersey, January, 1999.
93. **Modeling Brain Tumor Growth**, Seminar given at New York Hospital/ Cornell Medical School, New York, New York, March 1999.
94. **Reconstructing Random Media: An Intriguing Inverse Problem**, 81st Statistical Mechanics Meeting, Rutgers University, New Brunswick, New Jersey, May, 1999.
95. **Composites, Hard Core/Soft Shell Model, and Brain Tumor Growth**, 10th ACBM/NIST Computer Modelling Workshop, National Institute of Standards and Technology, Gaithersburg, Maryland, May, 1999.
96. **Exact Expression for the Effective Elastic Tensor of Disordered Composites**, Electrical, Transport and Optical Properties of Inhomogeneous Media V, Hong Kong, China, June, 1999.
97. **Cellular Automata of Brain Tumor Growth Dynamics**, Information Processing in Cells And Tissues, Indianapolis, Indiana, August, 1999 (with A. R. Kansal, G. R. Harsh, E. A. Chiocca and T. S. Deisboeck).

98. **Optimally Designed and Multifunctional Composites**, AFOSR Workshop on Structural Mechanics, Dayton, Ohio, September, 1999.
99. **Transport Properties and Microstructure of Porous Media**, Workshop on *Disordered Porous Materials*, Les Houches School of Physics, Les Houches, France, October, 1999.
100. **Generating Microstructures from Limited Statistical Information**, International Mechanical Engineering Conference, Nashville, Tennessee, November, 1999.
101. **Challenges in Multifunctional Material Optimization**, Defense Sciences Research Council Workshop on Optimization for Multifunctional Materials, Harvard University, Cambridge, Massachusetts, December, 1999.
102. **Modeling Brain Tumor Growth**, IBM Watson Research Center, Yorktown Heights, New York, January, 2000.
103. **Is Random Close Packing of Spheres Well Defined?**, Seminar given at California Institute of Technology, Pasadena, California, March, 2000.
104. **Link Between the Effective Properties and Microstructure of Random Heterogeneous Materials**, Workshop on *Homogenization and Effective Media Theories*, Mathematical Sciences Research Institute, Berkeley, California, March, 2000.
105. **Advances in the Physics of Random Heterogeneous Media**, Seminar given at Massachusetts Institute of Technology, Cambridge, Massachusetts, September, 2000.
106. **Random Heterogeneous Media: Microstructure and Macroscopic Properties**, Seminar given at Lehigh University, Bethlehem, Pennsylvania, September, 2000.
107. **Heterogeneous Materials: Bridging the Microscopic and Macroscopic Worlds**, Seminar given at Brown University, Providence, Rhode Island, October, 2000.
108. **Random Heterogeneous Materials: Bridging the Microscopic and Macroscopic Worlds**, International Mechanical Engineering Conference, Orlando, Florida, November, 2000.
109. **An Interdisciplinary Approach to Brain Tumor Growth Dynamics**, "Unanswered Questions and Pressing Challenges at the Interface of Biology and Engineering," International Mechanical Engineering Conference, Orlando, Florida, November, 2000.
110. **Revisiting an Old Concept: Random Close Packing of Hard Spheres**, Statistical Physics Seminar, Princeton University, Princeton, New Jersey, April, 2001.
111. **Revisiting an Old Concept: Random Close Packing of Hard Spheres**, Mathematical Physics Seminar, Rutgers University, New Brunswick, New Jersey, April, 2001.
112. **Theory of Composites**, 12th ACBM/NIST Computer Modelling Workshop, National Institute of Standards and Technology, Gaithersburg, Maryland, June, 2001.

113. **Optimization of Microstructure and Effective Properties of Heterogeneous Materials**, 2001 Mechanics and Materials Conference, San Diego, California, June, 2001.
114. **Random Heterogeneous Materials: Bridging the Microscopic and Macroscopic Worlds**, 2001 Mechanics and Materials Conference, San Diego, California, June, 2001.
115. **Toward the Maximally Random Jammed State of Sphere Packings**, "Challenges in Granular Physics," International Center for Theoretical Physics, Trieste, Italy, August, 2001.
116. **Toward the Maximally Random Jammed State of Particle Packings**, Exxon and Mobil Research, Annandale, New Jersey, October, 2001.
117. **Advances in the Microstructure and Properties of Heterogeneous Materials**, Seminar given at Northwestern University, Evanston, Illinois, November, 2001.
118. **Jamming, Glasses, and Order Metrics**, "Unifying Concepts in Glass Physics," Rome, Italy, February, 2002.
119. **Computational Approach to Brain Tumor Growth Dynamics, Heterogeneity, and Treatment**, Seminar given at the University of Virginia, Charlottesville, Virginia, March, 2002.
120. **Sphere Packings, Maximal Disorder, and Jamming**, Seminar given at the Massachusetts Institute of Technology, Cambridge, Massachusetts, April, 2002.
121. **Advances in the Microstructure and Properties of Heterogeneous Materials**, Seminar given at the University of California at Berkeley, Berkeley, California, April, 2002.
122. **Toward the Maximally Random Jammed State of Sphere Packings**, 87th Rutgers Statistical Mechanics Meeting, Rutgers University, New Brunswick, May, 2002.
123. **Computational Approach to Brain Tumor Growth Dynamics, Heterogeneity, and Treatment**, *Grand Rounds* presentation given in the Department of Neurosurgery at the University of Pennsylvania, Philadelphia, Pennsylvania, May, 2002.
124. **Maximally Random Jammed State of Sphere Packings**, 14th U.S. National Congress of Theoretical & Applied Mechanics, Virginia Tech, Blacksburg, Virginia, June, 2002.
125. **Statistical Models for Heterogeneous Materials**, Geometry and Mechanics of Structured Materials, Max Planck Institute for Complex Systems, Dresden, Germany, October, 2002.
126. **The Quantification of Disorder in Heterogeneous Materials**, 2002 ASME International Mechanical Engineering Congress, New Orleans, Louisiana, November, 2002.

127. **Sphere Packings, Order Metrics, and Jamming**, Seminar given at Cornell University, Ithaca, New York, April, 2003.
128. **Sphere Packings: Metastability, Randomness, and Jamming**, Seminar given at the University of Rome, La Sapienza, Rome, Italy, June, 2003.
129. **Local Density Fluctuations, Hyperuniformity, and Order Metrics**, Seminar given at the University of Rome, La Sapienza, Rome, Italy, July, 2003.
130. **Random Media: Correlation Functions and Optimization**, Seminar given at the University of Rome, La Sapienza, Rome, Italy, July, 2003.
131. **Self-Assembly, Statistical Mechanics, and Materials Optimization**, Invited talk given at the Department of Energy Workshop on New Directions in Mechanics, Warrenton, Virginia, September, 2003.
132. **Sphere Packings, Jamming, and Order Metrics**, Seminar given at Yale University, New Haven, Connecticut, October, 2003.
133. **The Brain as a Heterogeneous Material**, Physics of Neural Tissue Workshop, The Institute for Complex Adaptive Matter, Santa Fe, New Mexico, November, 2003.
134. **Particle Packings, Jamming, and Order Metrics**, Member's seminar given at the Institute for Advanced Study, Princeton, New Jersey, November, 2003.
135. **Local Density Fluctuations, Hyperuniformity, and Order Metrics**, 91st Rutgers Statistical Mechanics Meeting, Rutgers University, New Brunswick, May, 2004.
136. **Statistical Representation of Microstructures**, Gordon Research Conference on *Physical Metallurgy*, Holderness School, Plymouth, New Hampshire, July, 2004.
137. **Random Particle Packings, Jamming, and Glasses**, Workshop on *Flexibility in Complex Materials : Glasses, Amorphous Materials and Proteins* in honor of Michael Thorpe's 60th birthday, Sainte-Adèle, Québec, Canada, August, 2004.
138. **Optimally Designed Multifunctional Materials**, AFOSR Meeting on *Mechanics of Materials and Devices*, Wintergreen, Virginia, August, 2004.
139. **Particle Packings, Jamming, and Order Metrics** Seminar given at the University of Texas at Austin, August, 2004.
140. **Heterogeneous Materials: Property Estimates and Optimization**, Seminar given at the University of Texas at Austin, September, 2004.
141. **Sphere Packings, Order Metrics, and Jamming** Seminar given at Pennsylvania State University, September, 2004.
142. **Optimal Particle Packings: Problems for the Ages**, Plenary Prager Lecture, Society of Engineering Science, Lincoln, Nebraska, October, 2004.

143. **Local Density Fluctuations, Hyperuniformity, and Order Metrics**, Statistical Mechanics Seminar, Princeton University, Princeton, November, 2004.
144. **Optimization Methods in Materials Science**, Colloquium given at Princeton University in a colloquium in the PICASso/PICSciE series, Princeton, April, 2005.
145. **New Provisional Lower Bounds on the Optimal Density of Sphere Packings**, Banff Workshop on *Densest Packings of Spheres*, Banff, Canada, May, 2005.
146. **Optimal Particle Packings: Problems for the Ages**, *Frontiers in Soft Condensed Matter Workshop*, Exxon-Mobil Research and Engineering Company, Annandale, New Jersey, May, 2005.
147. **Optimization of Microstructure and Properties of Heterogeneous Materials**, Colloquium given at Schlumberger-Doll Research, Ridgefield, Connecticut, June, 2005.
148. **Jamming in Optimal Particle Packings**, *Conference on Granular Physics*, Kavli Institute for Theoretical Physics, UC Santa Barbara, June 2005.
149. **Random Heterogeneous Materials for Fun and Profit**, *Geophysical Fluid Dynamics Lecture Series*, Woods Hole Oceanographic Institute, Woods Hole, Massachusetts, July, 2005.
150. **Using Topology Optimization to Design Composites with Tailored Properties**, Seminar given at the Air Force Research Laboratory, Dayton, Ohio, August, 2005.
151. **Optimally Designed Multifunctional Materials**, AFOSR Meeting on *Mechanics of Materials and Devices*, Santa Fe, New Mexico, September, 2005.
152. **Random Heterogeneous Materials and Stochastic Geometry**, Plenary Lecture given in Honor of Dietrich Stoyan at the Workshop "Stochastic Geometry and Its Applications," October, 2005.
153. **An Interdisciplinary Approach to Tumor Growth Modeling**, Seminar given in the Department of Radiology, University of Pennsylvania, Philadelphia, Pennsylvania, October, 2005.
154. **Bounds on the Optimal Density of Sphere Packings in High Dimensions**, Colloquium given in the Program in Applied & Computational Mathematics, Princeton University, Princeton, New Jersey, November, 2005.
155. **Optimal Particle Packings: Problems for the Ages**, Seminar given in the Department of Physics, Syracuse University, Syracuse, New York, November, 2005.
156. **An Interdisciplinary Approach to Brain Tumor Growth Dynamics, Heterogeneity, and Treatment**, *Grand Rounds* presentation given in the Department of Neurosurgery at New York University School of Medicine, New York, New York, December, 2005.

157. **Optimal Particle Packings: Problems for the Ages**, Colloquium given at the Workshop “Physical and Mathematical Aspects of Packing Problems,” Aspen Center for Physics, Aspen, Colorado, June, 2006.
158. **Optimization of Material Microstructures for Fun and Profit**, Seminar given at Rohm and Haas Company, Spring House, Pennsylvania, July 2006.
159. **Optimal Particle Packings: Problems for the Ages**, Seminar given at Duke University, Durham, North Carolina, August, 2006.
160. **Order Metrics and Classical Ground States**, Seminar given at the Princeton Center for Theoretical Physics, Princeton University, Princeton, New Jersey, September, 2006.
161. **Optimal Particle Packings: Problems for the Ages**, Seminar given at the Benjamin Levich Institute for Physico-Chemical Hydrodynamics, City College of New York, New York, NY, November, 2006.
162. **Jamming Categories and Order Metrics**, Presentation given at the 96th Statistical Mechanics Meeting, Rutgers University, New Brunswick, New Jersey, December, 2006.
163. **Disordered Classical Ground States**, Berkeley Mini Statistical Mechanics Meeting, UC Berkeley, Berkeley, California, January, 2007.
164. **Can Disordered Spheres Packings Ever be Maximally Dense?** Workshop on “Packing Problems, Classical Ground States and Glasses,” Princeton Center for Theoretical Physics, Princeton University, Princeton, New Jersey, April, 2007.
165. **Optimally Designed Multifunctional Materials**, AFOSR Meeting on *Mechanics of Multifunctional Materials and Devices*, Monterey, California, June, 2007.
166. **Quantifying Randomness in Jammed Packings**, Presentation given at the “Jamming” Workshop, Aspen Center for Physics, Aspen, Colorado, July, 2007.
167. **Ensemble versus Statistical Geometric Approach in Jammed Packings**, Presentation given at the “Jamming” Workshop, Aspen Center for Physics, Aspen, Colorado, July, 2007.
168. **Polytope Picture in Jammed Sphere Packings**, Presentation given at the “Jamming” Workshop, Aspen Center for Physics, Aspen, Colorado, August, 2007.
169. **Sphere Packings in High Dimensions: Disorder versus Order**, Seminar given at the Institute for Advanced Study, Princeton, New Jersey, October, 2007.
170. **Packing Hyperspheres in High-Dimensional Euclidean Spaces**, Society of Engineering Sciences Annual Conference, Texas A&M University, College Station, Texas, October, 2007.



171. **Optimal Sphere Packings in High Dimensions: Disorder vs. Order**, Colloquium given at Laboratoire de Physique Théorique et Hautes Energies, Université Pierre et Marie Curie, Jussieu, Paris, France, March, 2008.
172. **Hyperuniform Point Processes and Classical Ground States**, Invited talk given in the *Workshop on Spatial Point Processes*, Université Pierre et Marie Curie, Jussieu, Paris, France, March, 2008.
173. **Growing Brain Tumors in Silico**, Seminar given to the Systems Biology Group in the School of Natural Sciences, Institute for Advanced Study, Princeton, New Jersey, April, 2008.
174. **Can Disordered Sphere Packings Ever Be Maximally Dense?**, Applied Mathematics and Computational Science Colloquium given at the University of Pennsylvania, Philadelphia, Pennsylvania, April, 2008.
175. **Particle Packing Problems in Low Space Dimensions**, PCCM Summer School on Condensed Matter Physics, Princeton University, Princeton, New Jersey, August, 2008.
176. **Can Disordered Sphere Packings Ever Be Maximally Dense?**, PCCM Summer School on Condensed Matter Physics, Princeton University, Princeton, New Jersey, August, 2008.
177. **Classical Disordered Ground States**, Physics Colloquium given at Vanderbilt University, Nashville, Tennessee, October, 2008.
178. **Can Disordered Sphere Packings Ever Be Maximally Dense?**, Applied Mathematics Colloquium, New Jersey Institute of Technology, Newark, New Jersey, December, 2008.
179. **Unusual Classical Ground States of Matter**, Applied and Computational Mathematics Colloquium, Princeton University, Princeton, New Jersey, February, 2009.
180. **Packing Hyperspheres in High Dimensions: Does Disorder Win?**, Physics Colloquium given at the University of Florida, Gainesville, Florida, April, 2009.
181. **Unusual Classical Ground States of Matter**, Computations in Science Seminars, James Franck Institute, University of Chicago, Chicago, Illinois, May, 2009.
182. **Dense Packings of Nonspherical Particles**, 7th Annual Northeastern Granular Materials Workshop, Yale University, New Haven, Connecticut, June, 2009.
183. **Jammed Particle Packings: From Kepler to Bernal and Beyond**, Widely Applied Mathematics Seminar, Harvard University, Cambridge, Massachusetts, September, 2009.
184. **Particle Packing Problems for Fun and Profit**, Colloquium given at Microsoft Research, Cambridge, Massachusetts, September, 2009.

185. **Inverse Optimization Techniques for Targeted Self-Assembly**, Synthesis and Processing Sciences Workshop, Office of Basic Energy Sciences, Warrenton, Virginia, October, 2009.
186. **From Unusual Ground States to Packing Problems**, Physics Colloquium given at New York University, New York, New York, December, 2009.
187. **Unusual Classical Ground States of Matter: Soft Interactions**, Geometry and Materials Seminar, School of Mathematics, Institute for Advanced Study, Princeton, New Jersey, February, 2010.
188. **Unusual Classical Ground States of Matter: Sphere Packings**, Geometry and Materials Seminar, School of Mathematics, Institute for Advanced Study, Princeton, New Jersey, March, 2010.
189. **Toward an Ising Model for Cancer and Beyond**, Workshop on "Understanding Cancer via the Theoretical Sciences," Princeton Center for Theoretical Science, Princeton University, Princeton, New Jersey, April, 2010.
190. **From Unusual Ground States to Packing Problems**, Conference on "Optimal Configurations on the Sphere and Other Manifolds," Vanderbilt University, Nashville, Tennessee, May, 2010.
191. **Particle Packing Problems: From Kepler and Beyond**, SIAM Conference on "Mathematical Aspects of Materials Science," Philadelphia, Pennsylvania, May, 2010.
192. **A Universal and Complete Descriptor of Material Microstructures**, Geometry and Materials Seminar, School of Mathematics, Institute for Advanced Study, Princeton, New Jersey, June, 2010.
193. **An Ising Model of Cancer and Beyond: A View from the CPU**, Workshop on "Cellular Differentiation and Response to Stress: Modeling Cancer Initiation and Progression," Sedona, Arizona, August, 2010.
194. **Reformulation of the Covering and Quantizer Problems as Ground States of Interacting Particles**, Colloquium given in the Program in Applied and Computational Mathematics, Princeton University, Princeton, New Jersey, December 2010.
195. **Toward an Ising Model of Cancer and Beyond**, Lewis-Sigler Institute Retreat, Princeton University, Princeton, New Jersey, January, 2011.
196. **Unusual Classical Ground States of Matter**, Materials Seminar, Courant Institute of Mathematical Sciences, New York University, New York City, New York, March, 2011.
197. **Reformulation of the Covering and Quantizer Problems as Ground States of Interacting Particles**, Mathematics Colloquium, Courant Institute of Mathematical Sciences, New York University, New York City, New York, March, 2011.

198. **Targeted Self-Assembly, Hyperuniformity, and Novel Photonic Materials**, 46th New England Complex Fluids Workshop, Yale University, New Haven, Connecticut, March, 2011.
199. **Unusual Classical Ground States of Matter**, Condensed Matter Physics Seminar, University of Rochester, Rochester, New York, May, 2011.
200. **Tumor Heterogeneity: Spatial Organization and Emergent Behaviors**, Workshop on the Physics of Tumor Heterogeneity, Princeton University, Princeton, New Jersey, June 2011.
201. **Sphere Packings, Density Fluctuations, Coverings, and Quantizers**, Workshop on Sphere Packing and Amorphous Materials, International Centre for Theoretical Physics, Trieste, Italy, July, 2011.
202. **Inverse Optimization Techniques for Targeted Self-Assembly**, Synthesis and Processing Sciences Workshop, Office of Basic Energy Sciences, Crystal City, Virginia, September, 2011.
203. **Characterization and Generation of Aperiodic Hyperuniform Systems**, Workshop on Towards Unifying Concepts in the Physics of Aperiodic Systems, Princeton Center for Theoretical Science, Princeton University, Princeton, New Jersey, October, 2011.
204. **Geometry and Physics in High-Dimensional Euclidean Spaces**, Presentation given at the 106th Statistical Mechanics Meeting, Rutgers University, New Brunswick, New Jersey, December, 2011.
205. **Toward an Ising Model of Cancer and Beyond: A Theorist's Perspective on Cancer**, Tutorial given at the 2012 March American Physical Society Meeting, Boston, Massachusetts, February, 2012.
206. **Packing Nonspherical Particles: All Shapes Are Not Created Equal** Presentation given at the 2012 March American Physical Society Meeting, Boston, Massachusetts, February, 2012.
207. **Reformulation of the Covering and Quantizer Problems as Energy Minimizations**, Fejes Tóth Lecture, Department of Mathematics and Statistics, University of Calgary, Calgary, Canada, April, 2012.
208. **Dense Packings of Nonspherical Bodies and New Tilings of Three-Dimensional Euclidean Space**, Discrete Geometry Seminar, Department of Mathematics and Statistics, University of Calgary, Calgary, Canada, April, 2012.
209. **Unusual Low-Temperature States of Matter: Challenging Orthodoxy**, Condensed Matter Theory Seminar, Department of Physics, Cornell University, Ithaca, New York, September, 2012.

210. **Packings, Density Fluctuations, Coverings and Quantizers**, Discrete Geometry and Combinatorics Seminar, Department of Mathematics, Cornell University, Ithaca, New York, September, 2012.
211. **Unusual Low-Temperature Classical States of Matter**, Soft Matter Seminar, University of Pennsylvania, Philadelphia, Pennsylvania, September, 2013.
212. **Unusual Low-Temperature States of Matter: Challenging Orthodoxy**, Department of Chemistry Colloquium, Princeton University, Princeton, New Jersey, October, 2012.
213. **Continuum Percolation and Duality with Equilibrium Hard-Hyperparticle Systems**, Workshop on Topology: Identifying Order in Complex Systems, University of Pennsylvania, Philadelphia, Pennsylvania, November, 2012.
214. **Designer Potentials and Dense Packings of Hard Nonspherical Particles**, Soft Condensed Matter Seminar, Department of Physics and Astronomy, University of Pennsylvania, Philadelphia, Pennsylvania, September, 2012.
215. **Disordered Particle Packings and Duality with Continuum Percolation**, Presentation given at the 2012 Materials Research Society Meeting, Boston, Massachusetts, November, 2012.
216. **Characterization and Generation of Aperiodic Hyperuniform Systems**, Soft Matter Seminar, University of Pennsylvania, Philadelphia, Pennsylvania, March, 2013.
217. **Unusual Low-Temperature States of Matter: Challenging Orthodoxy**, James Franck Institute Seminar, University of Chicago, Chicago, Illinois, April, 2013.
218. **Reconstructing Random Heterogeneous Materials for Fun and Profit**, Saint-Gobain Northboro Research and Development Center, Massachusetts, June, 2013.
219. **Designer Materials via Optimization Techniques**, Mid-Atlantic Soft Matter Workshop, University of Delaware, Newark, Delaware, July, 2013.
220. **Novel Designer Materials**, Colloquium given at the Eindhoven Multiscale Institute, Technical University, Eindhoven, Netherlands, September, 2013.
221. **Optimization in Heterogeneous Materials**, Colloquium given at the Eindhoven Multiscale Institute, Technical University, Eindhoven, Netherlands, September, 2013.
222. **Unifying Themes in the Geometry and Physics of Many-Particle Systems**, Keynote Lecture at the Workshop on the Geometry and Physics of Spatially Random Structures, Freudenstadt, Germany, September, 2013.
223. **Geometry and Physics in High-Dimensional Euclidean Spaces**, Mathematics Colloquium, Pennsylvania State University, State College, Pennsylvania, October, 2013.

224. **Inverse Optimization Techniques for Targeted Self-Assembly**, Synthesis and Processing Sciences Workshop, Office of Basic Energy Sciences, Crystal City, Virginia, October, 2013.
225. **Disordered Hyperuniform Many-Particle Systems: A New State of Matter**, Physics Colloquium, Columbia University, New York, New York, December, 2013.
226. **Hyperuniform Disordered Materials: A New State of Matter**, Berkeley Mini Statistical Mechanics Meeting, UC Berkeley, Berkeley, California, January, 2014.
227. **Maximally Random Jammed Particle Packings**, National Institute of Standards and Technology, Gaithersburg, Maryland, January, 2014.
228. **Disordered Hyperuniform Materials: New States of Matter**, Seminar given at the Laboratory for Non-Linear Spectroscopy, University of Florence, Florence, Italy, March 2014.
229. **Hyperuniformity, Jammed Disordered Packings and Novel Photonic Materials**, Invited Presentation given at Photonic Materials Workshop at the Laboratory for Non-Linear Spectroscopy, University of Florence, Florence, Italy, March 2014.
230. **Hyperuniformity and Novel Photonic Materials**, Seminar given at the University of Calabria, Cosenza, Italy, March, 2014.
231. **Disordered Hyperuniform Materials: New States of Matter**, Materials Science and Engineering Seminar, Massachusetts Institute of Technology, Cambridge, Massachusetts, April, 2014.
232. **Randomness, Hyperuniformity and Maximally Random Jammed Particle Packings**, Mechanical Engineering Seminar, Massachusetts Institute of Technology, Cambridge, Massachusetts, April, 2014.
233. **Disordered Hyperuniform Materials: New States of Matter**, Plenary Talk, American Conference of Theoretical Chemistry (ACTC) 2014, Telluride Science Research Center, Telluride, Colorado, July, 2014.
234. **New Algorithm to Generate Jammed Sphere Packings**, Conference on Computational Physics 2014, Boston University, Boston, Massachusetts, August, 2014.
235. **Disordered Energy Minimizing Configurations**, Workshop on Minimal Energy Point Sets, Lattices, and Designs," Erwin Schrödinger Institute, Vienna, Austria, October, 2014.
236. **Reformulation of the Covering and Quantizer Problems as the Ground States of Interacting Particles**, Workshop on Minimal Energy Point Sets, Lattices, and Designs," Erwin Schrödinger Institute, Vienna, Austria, October, 2014.
237. **Disordered Hyperuniform Materials: New States of Matter**, Colloquium Talk in the Program in Applied and Computational Mathematics, Princeton University, February, 2015.

238. **Disordered Hyperuniform Materials: New States of Matter**, Colloquium Talk in the Department of Physics, Carnegie-Mellon University, Pittsburgh, Pennsylvania, April, 2015.
239. **Ensemble Theory for Stealthy Hyperuniform Disordered Ground States**, 113th Rutgers Statistical Mechanics Meeting, Rutgers University, New Brunswick, May, 2015.
240. **Disordered Hyperuniform Point Patterns in Physics, Mathematics and Biology**, Shape Up: Exercises in Materials Geometry and Topology, Berlin, Germany, September, 2015.
241. **Designing Multifunctional Materials via Optimization Techniques**, Lawrence Livermore National Laboratory, Livermore, California, November, 2015.
242. **Disordered Hyperuniform Materials: New States of Amorphous Matter**, Materials Research Society Meeting, Boston, Massachusetts, December, 2015.
243. **Disordered Hyperuniform Point Patterns in Physics, Mathematics and Biology**, Predictive Multiscale Materials Modelling, Turing Gateway to Mathematics, Isaac Newton Institute, Cambridge University, Cambridge, England, December, 2015.
244. **Disordered Hyperuniform Many-Particle Systems: New States of Amorphous Matter**, Department of Chemistry, Cambridge University, Cambridge, England, December, 2015.
245. **Disordered Hyperuniform Materials: New States of Amorphous Matter**, Department of Materials Science and Engineering, Arizona State University, Tempe, Arizona, April, 2016.
246. **Disordered Hyperuniform Materials: Novel States of Amorphous Matter**, Society of Industrial and Applied Mathematics Conference on Mathematical Aspects of Materials Science, Philadelphia, Pennsylvania, May, 2016.
247. **Designing Novel Multifunctional Materials via Inverse Optimization Techniques**, Data Science and Optimal Learning for Material Discovery and Design, Sponsored by Los Alamos National Laboratory, Santa Fe, New Mexico, May, 2016.
248. **Optimal and Disordered Hyperuniform Point Configurations**, Workshop on Optimal and Random Point Configurations: From Statistical Physics to Approximation Theory, Institut Henri Poincaré, Paris, France, June, 2016.
249. **Number Variance, Sphere Packing, Covering and Quantizer Problems: Energy Minimizing Point Configurations**, Workshop on Optimal and Random Point Configurations: From Statistical Physics to Approximation Theory, Institut Henri Poincaré, Paris, France, June, 2016.
250. **Disordered Hyperuniform Materials: New States of Amorphous Matter**, ESPCI ParisTech, Paris, France, June, 2016.

251. **Fundamental Aspects of the Glass Transition**, Water and Water Systems, Ettore Majorana Foundation and Centre for Scientific Culture, Erice, Italy, July, 2016.
252. **Disordered Hyperuniform Materials: New States of Amorphous Matter**, Water and Water Systems, Ettore Majorana Foundation and Centre for Scientific Culture, Erice, Italy, July, 2016.
253. **Amorphous Trivalent and Tetrahedral Networks**, Water and Water Systems, Ettore Majorana Foundation and Centre for Scientific Culture, Erice, Italy, July, 2016.
254. **Design of Novel Materials via Optimization Techniques**, Sixth Karles Invitational Conference, Naval Research Laboratory, Washington, D.C., August, 2016.
255. **Disordered Hyperuniform Materials: New States of Amorphous Matter**, Materials Science and Engineering Seminar, University of Pennsylvania, Philadelphia, Pennsylvania, September, 2016.
256. **Continuum Percolation and Duality with Hard-Particle Systems Across Dimensions**, ICERM 16 Workshop on Stochastic Topology and Thermodynamic Limits, Brown University, Providence, Rhode Island, October, 2016.
257. **Hyperuniform States of Matter: Overview and Progress Report**, Princeton Center for Theoretical Science Workshop on Hyperuniform States of Matter in Physics, Mathematics and Biology, Princeton University, Princeton, New Jersey, December, 2016.
258. **Hyperuniformity of Many-Particle Systems and Its Generalizations**, Analysis Math-Physics Seminar, School of Mathematics, Institute for Advanced Study, Princeton, New Jersey, March, 2017.
259. **Disordered Hyperuniform Materials: New States of Amorphous Matter**, ExxonMobil Research and Engineering Company, Annandale, New Jersey, April, 2017.
260. **Disordered Hyperuniform Many-Particle Systems: New States of Amorphous Matter**, Physics Colloquium, Tufts University, Cambridge, Massachusetts, May, 2017.
261. **Materials Discovery via Optimization Techniques**, ExxonMobil 'Longer Range Research Meeting,' Sponsored by ExxonMobil and Princeton Andlinger Center, Princeton Marriott at Forrestal, New Jersey, May, 2017.
262. **Random Heterogeneous Materials for Fun and Profit**, ExxonMobil Research and Engineering Company, Annandale, New Jersey, May, 2017.
263. **Design of Hyperuniform Materials with Novel Properties**, PRISM Annual Research Symposium, Princeton University, Princeton, New Jersey, March 2018.
264. **Hyperuniform Point Configurations**, ICERM 18 Workshop on Computation and Optimization of Energy, Packing, and Covering, Brown University, Providence, Rhode Island, April, 2018.

265. **Hidden Large-Scale Order in Biological Patterns and Collective Behavior**, Princeton Center for Theoretical Science Workshop on Regular Patterns in Biology: Causes and Consequences, Princeton University, Princeton, New Jersey, April, 2018.
266. **Uncovering Multiscale Order in the Prime Numbers via Scattering**, 119th Rutgers Statistical Mechanics Meeting, Rutgers University, New Brunswick, May, 2018.
267. **Disordered Hyperuniform Materials: New States of Amorphous Matter**, National Institute of Standards and Technology, Gaithersburg, Maryland, June, 2018.
268. **Novel Physical Properties of Disordered Stealthy Hyperuniform Materials and Bounded-Hole-Size Property**, Workshop on “Correlated Disorder, Hyperuniformity and Local Self-Similarity,” University of Surrey, Surrey, England, June, 2018.
269. **Large-Scale Density Fluctuations and Hyperuniformity: Many-Body Systems**, Water and Water Systems, Ettore Majorana Foundation and Centre for Scientific Culture, Erice, Italy, July, 2018.
270. **Large-Scale Density Fluctuations and Hyperuniformity: Network and Water Systems**, Water and Water Systems, Ettore Majorana Foundation and Centre for Scientific Culture, Erice, Italy, July, 2018.
271. **Disordered Hyperuniform States of Matter**, Workshop of “Correlated Disorder and Hyperuniformity in Soft Matter and Photonics,” Paris, France, July, 2018.
272. **Large-Scale Density Fluctuations and Hyperuniformity in the Physical, Mathematical and Biological Sciences**, Penn Institute for Computational Science Colloquium, University of Pennsylvania, Philadelphia, Pennsylvania, October, 2018.
273. **Uncovering Multiscale Order in the Prime Numbers via Scattering**, Colloquium given at the Courant Institute of Mathematical Sciences, New York City, New York, November, 2018.
274. **Tailored Disordered Hyperuniform Materials with Novel Properties**, Presentation given at the 2012 Materials Research Society Meeting, Boston, Massachusetts, November, 2018.
275. **”Generation of Disordered Hyperuniform Materials with Novel Physical Properties**, Presentation given at the International Conference on “Colloidal Science and Metamaterials,” Institut Pierre-Gilles de Gennes, Paris, France, February, 2019.



## PATENTS

**“Narrow-Band Frequency Filters and Splitters, Photonic Sensors, and Cavities Having Pre-Selected Cavity Modes,”** Inventors: Paul J. Steinhardt, Marian Florescu, and Salvatore Torquato, US Patent No. 9465141 B2; Date of Patent: February 6, 2018.

**“Non-Crystalline Materials Having Complete Photonic, Electronic, or Phononic Band Gaps,”** Inventors: Paul J. Steinhardt, Salvatore Torquato and Marian Florescu, United States Patent 10175389B2, publication date: January 8, 2019.

## PUBLICATIONS

Torquato’s published work has been cited over 34,500 times and his h-index is 98 as of June 14, 2018, according to Google Scholar.

### Books

S. Torquato, **Random Heterogeneous Materials: Microstructure and Macroscopic Properties**, Springer-Verlag, New York, 2002.

### Chapters in Books

1. S. Torquato, “Diffusion-Absorption and Flow Processes in Disordered Porous Media,” in **Heterogeneous Media: Topics in Mathematical Modelling Methods**, Edited by K. Markov and L. Preziosi, Birkhauser, Boston (2000).
2. S. Torquato, “Modeling of Physical Properties of Composite Materials,” in **Research Trends in Solid Mechanics**, Edited by G. J. Dvorak, Elsevier Science Ltd., Oxford, United Kingdom (2000).
3. S. Torquato, “Theory of Random Heterogeneous Materials,” in **Handbook of Materials Modeling**, Ed. Sidney Yip, Springer-Verlag, New York, 2005.
4. S. Torquato, “Microstructure Optimization,” in **Handbook of Materials Modeling**, Ed. Sidney Yip, Springer-Verlag, New York, 2005.

### Special Invited Articles

S. Torquato, “Glass Transition: Hard Knock for Thermodynamics,” **Nature**, **405**, 521, 2000.

M. E. Kassner, S. Nemat-Nasser, Z. Suo, G. Bao, J. C. Barber, K. Brinson, H. Espinosa, S. Granick, P. Gumbsch, K-S. Kim, W. Knauss, L. Kubin, J. Langer, B. C. Larson, L. Mahadevan, A. Majumdar, S. Torquato, and F. van Swol, "New Directions in Mechanics," **Mechanics of Materials**, **37**, 231 (2004).

## Articles

1. S. Torquato and G. Stell, "Latent Heat of Vaporization of a Fluid," **Journal of Physical Chemistry**, **85**, 3029 (1981).
2. S. Torquato and G. Stell, "An Equation for the Latent Heat of Vaporization," **Industrial and Engineering Chemistry Fundamentals**, **21**, 202 (1982).
3. S. Torquato and G. Stell, "Microstructure of Two-Phase Random Media. I. The n-Point Probability Functions," **Journal of Chemical Physics**, **77**, 2071 (1982).
4. S. Torquato and G. Stell, "Microstructure of Two-Phase Random Media. II. The Mayer-Montroll and Kirkwood-Salsburg Hierarchies," **Journal of Chemical Physics**, **78**, 3262 (1983).
5. S. Torquato and G. Stell, "Microstructure of Two-Phase Random Media. III. The n-Point Matrix Probability Functions for Fully Penetrable Spheres," **Journal of Chemical Physics**, **79**, 1505 (1983).
6. S. Torquato and G. Stell, "Microstructure of Two-Phase Random Media. IV. Expected Surface Area of a Dispersion of Penetrable Spheres and Its Characteristic Function," **Journal of Chemical Physics**, **80**, 878 (1984).
7. S. Torquato and P. Smith, "Latent Heat of Vaporization of a Widely Diverse Class of Fluids," **Journal of Heat Transfer**, **106**, 252 (1984).
8. S. Torquato, "Bulk Properties of Two-Phase Disordered Media. I. Cluster Expansion for the Effective Dielectric Constant of Dispersions of Penetrable Spheres," **Journal of Chemical Physics**, **81**, 5079 (1984).
9. S. Torquato and F. Lado "Characterisation of the Microstructure of Distributions of Rigid Rods and Discs in a Matrix," **Journal of Physics A: Mathematics & General**, **18**, 141 (1985).
10. S. Torquato and G. Stell, "Microstructure of Two-Phase Random Media. V. The n-Point Matrix Probability Functions for Impenetrable Spheres," **Journal of Chemical Physics**, **82**, 980 (1985).
11. S. Torquato and G. Stell, "Bounds on the Effective Thermal Conductivity of a Dispersion of Fully Penetrable Spheres," **International Journal of Engineering Science**, **23**, 375 (1985).
12. S. Torquato, G. Stell and J. D. Beasley, "Third-Order Bounds on the Effective Bulk and Shear Moduli of a Dispersion of Fully Penetrable Spheres," **International Journal of Engineering Science**, **23**, 385 (1985).
13. J. M. Haile, C. Massobrio, and S. Torquato, "Two-Point Probability Function for Two-Phase Random Media: Computer-Simulation Results for Impenetrable Spheres," **Journal of Chemical Physics**, **83**, 4075 (1985).

14. S. Torquato, "Bulk Properties of Two-Phase Disordered Media. II. Effective Conductivity of a Dilute Dispersion of Penetrable Spheres," **Journal of Chemical Physics**, **83**, 4776 (1985).
15. S. Torquato, "Effective Electrical Conductivity of Two-Phase Disordered Composite Media," **Journal of Applied Physics**, **58**, 3790 (1985).
16. S. Torquato and J. D. Beasley, "Effective Properties of Fiber-Reinforced Materials. I. Bounds on the Effective Thermal Conductivity of Dispersions of Fully Penetrable Cylinders," **International Journal of Engineering Science**, **24**, 415 (1986).
17. S. Torquato and J. D. Beasley, "Effective Properties of Fiber-Reinforced Materials. II. Bounds on the Effective Elastic Moduli of Dispersions of Fully Penetrable Cylinders," **International Journal of Engineering Science**, **24**, 435 (1986).
18. F. Lado and S. Torquato, "Effective Properties of Two-Phase Disordered Composite Media. I. Simplification of Bounds on the Conductivity and Bulk Modulus of Dispersions of Impenetrable Spheres," **Physical Review B**, **33**, 3370 (1986).
19. S. Torquato and F. Lado, "Effective Properties of Two-Phase Disordered Composite Media: II. Evaluation of Bounds on the Conductivity and Bulk Modulus of Dispersions of Impenetrable Spheres," **Physical Review B**, **33**, 6428 (1986).
20. S. Torquato, "Bulk Properties of Two-Phase Disordered Media. III. New Bounds on the Effective Conductivity of Dispersions of Penetrable Spheres," **Journal of Chemical Physics**, **84**, 6345 (1986).
21. S. Torquato, "Effective Transport Properties of Multiphase Media from the Microstructure," **Advances in Multiphase Flow and Related Problems**, Edited by G. Papanicolaou, Society for Industrial and Applied Mathematics, 238 (1986).
22. S. Torquato, "Interfacial Surface Statistics Arising in Diffusion and Flow Problems in Porous Media," **Journal of Chemical Physics**, **85**, 4622 (1986).
23. J. D. Beasley and S. Torquato, "Bounds on the Conductivity of Suspensions of Impenetrable Spheres," **Journal of Applied Physics**, **60**, 3576 (1986).
24. S. Torquato, "Two-Point Distribution Function for a Dispersion of Impenetrable Spheres in a Matrix," **Journal of Chemical Physics**, **85**, 6248 (1986).
25. S. Torquato, "Concentration Dependence of Diffusion-Controlled Reactions Among Static Reactive Sinks," **Journal of Chemical Physics**, **85**, 7178 (1986).
26. S. Torquato, "Microstructure Characterization and Bulk Properties of Disordered Two-Phase Media," **Journal of Statistical Physics**, **45**, 843 (1986).
27. S. Torquato and J. D. Beasley, "Bounds on the Permeability of a Random Array of Partially Penetrable Spheres," **Physics of Fluids**, **30**, 633 (1987).

28. S. Torquato, "Bounds on the Thermal Conductivity of Disordered Heterogeneous Media," **Proceedings of the 1987 ASME/JSME Thermal Engineering Conference**, **2**, 359 (1987).
29. S. Torquato, "Characterization of the Microstructure of Disordered Media: A Unified Approach," **Physical Review B**, **35**, 5385 (1987).
30. S. Torquato, F. Lado, and P. A. Smith, "Bulk Properties of Two-Phase Disordered Media. IV. Mechanical Properties of Suspensions of Penetrable Spheres at Nondilute Concentrations," **Journal of Chemical Physics**, **86**, 6388 (1987).
31. S. Torquato, "Transport Properties of Disordered Composite Materials from the Microstructure," **6th International Conference on Composite Materials**, London, England, Vol. 4, 302 (1987).
32. P. M. Richards and S. Torquato, "Upper and Lower Bounds for the Rate of Diffusion-Controlled Reactions," **Journal of Chemical Physics**, **87**, 4612 (1987).
33. A. K. Sen, F. Lado, and S. Torquato, "Bulk Properties of Composite Media. I. Simplification of Bounds on the Shear Modulus of Suspensions of Impenetrable Spheres," **Journal of Applied Physics**, **62**, 3503 (1987).
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35. S. Torquato, "Thermal Conductivity of Disordered Heterogeneous Media from the Microstructure," **Reviews in Chemical Engineering**, **4**, 151 (1987).
36. P. A. Smith and S. Torquato, "Computer Simulation Results for the Two-Point Probability Function of Composite Media," **Journal of Computational Physics**, **76**, 176 (1988).
37. S. Torquato and F. Lado, "Bounds on the Conductivity of a Random Array of Cylinders," **Proceedings of the Royal Society of London A**, **417**, 59 (1988).
38. S. Torquato, J. D. Beasley, and Y. C. Chiew, "Two-Point Cluster Function for Continuum Percolation," **Journal of Chemical Physics**, **88**, 6540 (1988).
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40. S. Torquato and F., "Bounds on the Effective Transport and Elastic Properties of a Random Array of Cylindrical Fibers in a Matrix," **Journal of Applied Mechanics**, **55**, 347 (1988).
41. S. Torquato, "Transport Properties of Disordered Heterogeneous Media from the Microstructure," **Proceedings from the Sixth Symposium on Energy Engineering Sciences**, DOE CONF-8805106, 172 (1988).

42. S. B. Lee and S. Torquato, "Porosity for the Penetrable-Concentric-Shell Model of Two-Phase Disordered Media: Computer-Simulation Results," **Journal of Chemical Physics**, **89**, 3258 (1988).
43. A. K. Sen and S. Torquato, "Series Expansions for Clustering in Continuum- Percolation Models with Interactions," **Journal of Chemical Physics**, **89**, 3799 (1988).
44. S. B. Lee and S. Torquato, "Pair-Connectedness and Mean Cluster Size for Continuum-Percolation Models: Computer-Simulation Results," **Journal of Chemical Physics**, **89**, 6427 (1988).
45. P. A. Smith and S. Torquato, "Computer Simulation Results for Bounds on the Effective Conductivity of Composite Media," **Journal of Applied Physics**, **65**, 893 (1989).
46. S. Torquato and J. Rubinstein, "Diffusion-Controlled Reactions. II. Further Bounds on the Rate Constant," **Journal of Chemical Physics**, **90**, 1644 (1989).
47. J. D. Beasley and S. Torquato, "New Bounds on the Permeability of a Random Array of Spheres," **Physics of Fluids A**, **1**, 199 (1989).
48. A. K. Sen and S. Torquato, "Effective Conductivity of Anisotropic Two-Phase Composite Media," **Physical Review B**, **39**, 4504 (1989).
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